FINAL
TASK-SPECIFIC PLAN FOR THE BUILDING 157 SCOPING SURVEY

Prepared under the
HUNTERS POINT SHIPYARD
BASE-WIDE RADIOLOGICAL WORK PLAN
May 17, 2006
DCN: ECSD-RACIV-06-0204

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TETRA TECH EC, INC.

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May 18, 2006
ECSD-RACIV-06-0204
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Base Realignment and Closure
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SUBJECT: FINAL TASK-SPECIFIC PLAN FOR THE BUILDING 157 SCOPING SURVEY, HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

Reference: Contract N62473-06-D-2201, Environmental Remedial Action Contract For Sites Southern California, Arizona, New Mexico, and Southern Nevada

Dear Pat Brooks

Enclosed is the Final Task-Specific Plan for the Building Survey 157 Scoping Survey, Hunters Point Shipyard, San Francisco, California dated May 17, 2006. If you have any questions or require additional information, please contact me at (619) 471-3544.

Sincerely,

Ryan Ahlersmeyer
Project Manager

Enclosures: Final Task-Specific Plan for the Building Survey 157 Scoping Survey

TASK-SPECIFIC PLAN
FOR
BUILDING 157 SCOPING SURVEY

This Task-specific Plan (TSP) provides task-specific details for the scoping survey at Building 157 at Hunters Point Shipyard (HPS). The survey will be conducted in accordance with the general approach and methodologies that are given in the *Base-wide Radiological Work Plan* (Base-wide Plan; DCN: FWSD-RAC-05-0165) (Tetra Tech FW, Inc. [TtFW], 2005a) and the Standard Operating Procedures (SOPs). The survey activities will conform to the requirements of the Base-wide Health and Safety Plan (HSP) (TtFW, 2004) and the Building-specific Health and Safety Plan (BHASP) that will be prepared for the site. No exceptions to the Base-wide Plan, SOPs, or HSP are noted.

This survey is being performed to determine if residual radioactivity is present at the site. The survey has been designed as a *Multi-Agency Radiological Site Survey and Investigation Manual* (MARSSIM) (NUREG-1575; Department of Defense [DoD] et al., 2000) Class 1 and Class 2 survey. This methodology will allow the use of the survey data to support the Final Status Survey if no contamination is found to exceed the release criteria.

1.0 SITE DESCRIPTION AND HISTORICAL SUMMARY

Building 157 is a corrugated metal, wood-framed structure approximately 40 feet by 140 feet in size. Building 157 is located in Parcel B northwest of Building 140; no specific reference or historical description which indicates a year of construction can be located. The total surface area of the Class 1 survey units is approximately 528 square meters (m^2).

The Historical Radiological Assessment (HRA), Volume II (Naval Sea Systems Command [NAVSEA], 2004), states that Building 157 was previously used for the following purposes:

- Shipyard Industrial Laboratory
- Non-Destructive Testing (NDT)
- Sound Laboratory
- Metals Testing Center (Radiography)
- Metal Shop

Building 157 is radiologically impacted, due to the use and storage of general radioactive material (G-RAM) on the premises. It is currently vacant. The planned future use identified in the San Francisco Redevelopment Agency Reuse (SFRA) Plan (SFRA, 1997) is as a "mixed use" area, which includes residential areas.

As identified in the HRA, the isotopes of concern at Building 157 are cesium-137 (^{137}Cs), radium-226 (^{226}Ra) and cobalt-60 (^{60}Co).

2.0 SURVEY DESCRIPTION

Building 157 will be surveyed in two separate stages. The first stage will be to survey the corrugated metal-framed structure and the remaining concrete slab foundation for demolition and disposal. The

second stage will be to conduct a scoping survey designed as a Class 1 and 2 MARSSIM survey once the building structure and concrete pad have been removed.

2.1 Corrugated Metal-framed Structure and Concrete Pad Survey

Prior to performing scoping surveys at the Building 157 site, the Building 157 corrugated metal-framed structure and concrete pad will be surveyed for unconditional release in accordance with SOP HPO-Tt-006, *Radiation and Contamination Surveys* (TtFW, 2005b). Surveys will consist of scanning 100 percent of accessible surfaces inclusive of the structure and building materials for alpha and beta radiation, as well as performing a minimum of 32 static measurements for alpha and beta radiation. Additional biased static measurements will be performed at any location exhibiting elevated readings during the scan surveys. Swipe samples will be collected at each static measurement location and analyzed for alpha and beta contamination. Solid samples may be collected if elevated measurements are detected.

2.1.1 Release Criteria

Survey results will be compared to the release criteria for equipment and materials defined in Table 2-1. Once the Building 157 structure and concrete pad have been unconditionally released, it will be demolished and removed. Documentation for release of building structural and slab materials will be submitted prior to release of materials from HPS for unrestricted disposition and included in the post survey report.

2.1.2 Reference Area

The reference (background) area for both the concrete slab foundation and building material surveys are inside of Building 258. It is similar in composition to Building 157.

2.1.3 Investigation Levels

The investigation levels for alpha and beta surveys will be 100 disintegrations per minute (dpm)/100 square centimeters (cm^2) alpha and 5,000 dpm/100 cm^2 beta.

2.1.4 Scan Measurements

Scan measurements are performed to identify elevated areas of radioactivity within the survey unit. Alpha and beta scans will be effective for identifying elevated concentrations of the isotopes of concern. One hundred percent of the concrete slab and building materials will be scanned with Ludlum Model 43-37 or 43-68 gas-flow proportional detectors coupled to Ludlum Model 2360 data loggers.

2.1.4.1 Alpha Scan Measurements

Preliminary survey data indicates that the alpha count rate on various surfaces in Building 258 averages less than 10 counts per minute (cpm) with a Model 43-37 detector. Therefore, alpha scan speeds will be determined using Equation 7-4 from the Base-wide Plan (TtFW, 2005a).

Equation 7-4 from the Base-wide Plan

$$P(n \geq 2) = 1 - \left[1 + \frac{(GE + B)t}{60}\right]\left[e^{\frac{-(GE+B)t}{60}}\right]$$

Where:

$P(n \geq 2)$	=	probability of getting two or more counts during the time interval t(%)
t	=	time interval (s) = 11.7
G	=	contamination activity (dpm) = 100
E	=	detector efficiency (4π) = 0.158
B	=	observed background count rate (cpm) = 5.1
$P(n \geq 2)$	=	91 % at a scan speed of 1.2 centimeters per second (cm/s)

The scan surveys will be performed using a Ludlum Model 43-37 or 43-68 detector. The detector position will be adjusted so that the detector window is approximately 1/4 inch from the building surfaces. The surveyor will move the detector at a scan speed of 1.2 cm/s while maintaining audio and visual observation of the instrument response. If the surveyor observes two or more counts during a scan interval (approximately 12 seconds), the surveyor will pause the detector movement for 5-seconds to obtain additional data. If during the 5 second observation no additional counts are observed, the surveyor can continue the scan survey. Conversely, if additional counts are observed during the 5-second observation, the surveyor should mark the area for further investigation and subsequent biased measurements using a 126-cm^2 or smaller detector to locate and properly quantify any areas of elevated activity.

Preliminary survey data indicate that the alpha count rate on various surfaces in Building 258 averages less than 2 cpm with a Model 43-68 detector. When using a 126 cm^2 or smaller detector, scanning for alpha emitters differs in that the expected background response of most alpha detectors is very close to zero. Since the amount of time a contaminated area is under the probe varies and the background count rate of some alpha instruments is less than 1 cpm, it is not reasonable to determine a fixed minimum detectable concentration (MDC) for scanning. Instead, it is more practical to determine the probability of detecting an area of contamination at a predetermined derived concentration guideline level (DCGL) for given scan rates.

For alpha survey instrumentation with backgrounds ranging from less than 1 to 3 cpm, a single count provides a surveyor sufficient cause to stop and investigate further. Assuming this to be true, the probability of detecting given levels of alpha surface contamination can be calculated by use of Poisson summation statistics.

Given a known scan rate and a surface contamination release limit, the probability of detecting a single count while passing over the contaminated area is given by Equation 7-2 of the Base-wide Plan (TtFW, 2005a):

Equation 7-2 from the Base-wide Plan

$$P(n \geq 1) = 1 - e^{\frac{GEd}{60v}}$$

Where:

$P(n \geq 1)$	=	probability of observing a single count = 84.8%
G	=	contamination activity dpm = 100
E	=	detector efficiency (4π) = 0.0785
d	=	width of detector in direction of scan (centimeters [cm]) = 14.4
v	=	scan speed (cm/s) = 1.0

Once a count is recorded and the guideline level of contamination is present, the surveyor should stop and wait until the probability of getting another count is at least 90 percent. This time interval can be calculated by Equation 7-3 of the Base-wide Plan (TtFW, 2005a):

Equation 7-3 from the Base-wide Plan

$$t = \frac{13,800}{CAE}$$

Where:

t	=	time period for static count(s) = 13.95
C	=	contamination guideline (dpm/100 cm^2) = 100
A	=	physical probe area (cm^2) = 126
E	=	detector efficiency (4π) = 0.0785

Using the above equations found in the Base-wide Plan and Chapter 6 of MARSSIM (NUREG-1575; DoD et al., 2000), the probability of detecting 100 dpm/100 cm^2 alpha is 84.8 percent. Once an elevated area is identified, it is necessary to stop over the area and pause for 16 seconds to confirm the elevated reading. If elevated count rates are detected during this pause, then a static reading will be taken over the area in accordance with section 2.1.6.

2.1.4.2 Beta Scan Measurements

The minimum number of net source counts in the scan interval can be arrived at by multiplying the square root of the number of background counts (in the scan interval) by the detectability value associated with the desired performance (as reflected in d') as shown in Equation 7-5 from the Base-wide Plan (TtFW, 2005a) as follows:

Equation 7-5 from the Base-wide Plan

$$MDCR = d'\sqrt{b_i}\left(\frac{60}{i}\right)$$

Where:

d'	=	index of sensitivity (α and β errors [performance criteria])
b_i	=	number of background counts in scan time interval (count)
i	=	scan or observation interval (s)

For beta scans:

d′ = 3.28
b_i = 37.8 counts (based on background field measurements of 567 cpm)
i = 14 cm / 3.5 cm/s ~4 seconds

Beta scan minimum detectable count rate (MDCR) = 302 cpm at a scan speed of 3.5 cm/s.

The scan MDC is determined from the MDCR by applying conversion factors that account for detector and surface characteristics and surveyor efficiency. As discussed below, the MDCR accounts for the background level, performance criteria (d′), and observation interval. The observation interval during scanning is the actual time that the detector can respond to the contamination source. This interval depends on the scan speed, detector size in the direction of the scan, and area of elevated activity. The scan MDC for structure surfaces is calculated using Equation 7-6 from the Base-wide Plan (TtFW, 2005a) as follows:

Equation 7-6 from the Base-wide Plan

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i \varepsilon_s \frac{W_A}{100\ cm^2}}$$

Where:

$MDCR$ is discussed above
p = surveyor efficiency factor
ε_i = instrument efficiency (count per particle)
ε_s = contaminated surface efficiency (particle per disintegration)
W_A = area of the detector window (cm^2)

For beta scans:

$MDCR$ = 302
p = 0.50
ε_i = 0.302
ε_s = 0.25
W_A = 582

Beta scan MDC = 972 dpm/100 cm^2 at a scan speed of 3.5 cm/s.

2.1.5 Alpha and Beta Static Measurements

Two-minute alpha and beta static measurements will be performed at biased locations on building materials to achieve the MDC limits necessary for the isotopes of concern. Additional measurements may be collected if elevated radiation readings are identified while performing the scan surveys. Ludlum Model 43-68 gas-flow proportional detectors coupled to Ludlum Model 2360 data loggers will be used to perform alpha and beta static measurements.

The MDC for alpha measurements was calculated from preliminary Building 258 measurements using Equation 7-7 from the Base-wide Plan (TtFW, 2005a) as follows:

Equation 7-7 from the Base-wide Plan

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{\varepsilon_s \varepsilon_i \frac{W_A}{100} T_B}$$

Where:

3+4.65	=	constant factor provided in MARSSIM
R_B	=	Background Count Rate = 2 cpm
T_B	=	Background Count Time = 2 minutes
ε_i	=	Instrument Efficiency = 0.314
ε_s	=	Surface Efficiency Factor = 0.25
W_A	=	Probe Area Size = 126 cm^2

The calculated MDC (based on preliminary measurements) for alpha contamination is 62 dpm/100 cm^2, using a 2-minute static counting time.

The MDC for beta measurements were also calculated using Equation 7-7 from the Base-wide Plan (TtFW, 2005a) as follows:

Where:

3+4.65	=	constant factor provided in MARSSIM
R_B	=	Background Count Rate = 358 cpm
T_B	=	Background Count Time = 2 minutes
ε_i	=	Instrument Efficiency = 0.328
ε_s	=	Surface Efficiency Factor = 0.25
W_A	=	Probe Area Size = 126 cm^2

The calculated MDC (based on preliminary measurements) for beta contamination is 617 dpm/100 cm^2, using a 2-minute static counting time.

2.1.6 Media Sampling

Swipe samples will be collected at all static surveillance points, once static measurements have been obtained. Samples will be analyzed using NWT's SOP for analysis of gross alpha and beta. Additional measurements and solid samples may be collected if elevated radiation readings are identified while performing the scan and/or static surveys. Samples will be collected using SOP HPO-Tt-009, *Sampling Procedures for Radiological Surveys* (TtFW, 2005c).

Solid samples will be analyzed in the field laboratory by gamma spectroscopy. Ten percent of the samples will then be forwarded to an outside laboratory for quality assurance verification of gamma spectroscopy analysis. Additional samples will be analyzed for ^{90}Sr if elevated levels of ^{137}Cs are identified during field laboratory gamma spectroscopy analysis.

2.1.7 Ventilation Systems

Ventilation systems within the building will be surveyed as follows. One hundred percent scan surveys for alpha, beta, and gamma radiation will be conducted on the accessible exterior and interior surfaces of ventilation systems. Biased static alpha, beta, and gamma measurements will be collected from the exterior and accessible interior surfaces of the ventilation systems.

While performing the ventilation system surveys, particular emphasis will be placed on collecting survey data from likely accumulation points and areas that produce elevated scan measurement results.

2.1.8 Equipment and Materials

One hundred percent scan surveys for alpha and beta radiation will be conducted on the accessible surfaces of equipment and materials. Biased static alpha and beta measurements will be collected from the surfaces. A minimum of 1 static measurement will be collected at the location exhibiting the highest alpha/beta radiation measurement. Additional measurements will be collected at locations where the investigation level is exceeded. Materials identified as having contamination present above the levels specified in Table 2-1 will be packaged for subsequent decontamination or storage and disposal.

2.2 Post-building Demolition

Once the slab and building materials have been removed, the Building 157 site will be surveyed as three survey units. The location where the building stood will be divided into two Class 1 survey units. The surrounding 4 meters of the remaining footprint will be a Class 2 survey unit.

2.2.1 Survey Units

Two survey units (SU1and SU2) will encompass the Building 157 site footprint, and one survey unit (SU3) will encompass an area surrounding the adjacent 4 meters on all four sides of the footprint. SU1 and SU2 measure approximately 12 meters by 22 meters with an area of about 264 m^2 each. SU3 measures approximately 20 meters by 52 meters with a total area of about 512 m^2. The survey units will be identified as 06-N-157-1, 06-N-157-2, and 06-N-157-3, which will be used in the sample identification numbering. Systematic data collection locations, based on a random start point, have been generated and identified in Figure 2-1.

Since the radionuclides of concern are present in background, N is calculated in the manner specified for the Wilcoxon Rank-Sum test (Equation 5-1, Base-wide Plan [TtFW, 2005a]).

Equation 5-1 from the Base-wide Plan

$$N = \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{3\left(P_r - 0.5\right)^2}(1.2)$$

Where:

$Z_{1-\alpha}$ = 1.645 Type I decision error level
$Z_{1-\beta}$ = 1.645 Type II decision level
P_r = 0.921319 random measurement probability [from Table 5.1 in MARSSIM (NUREG-1575)]
(1.2) = 20% increase in number of samples over the minimum

Variables used to calculate N not already specified in the Base-wide Plan are Δ and σ. The values used for these parameters were 0.018 picocuries per gram (pCi/g) and 0.009 pCi/g, respectively. The value for Δ was derived using ½ of the release criteria for ^{60}Co, which has the most conservative release criterion for the site. The estimated value for σ is based on half of the value for Δ. Using Equation 5-1 from the Base-wide Plan, N is calculated as 26 total samples, 13 samples from the survey unit, and 13 samples from the reference area. In order to further increase the power of the statistical tests that will be performed using the data and to provide for the possibility of lost or invalid data, 16 systematic samples will be collected from each area.

The data collection locations, shown in Figure 2-1, will be placed in the field using global positioning system (GPS) technology.

2.2.2 Release Criteria

This survey is being performed to assess if residual radioactivity above the established release criteria, as defined in Table 2-2, is present in the area. The site will be modeled using radionuclide concentrations to evaluate total dose.

2.2.3 Reference Area

The reference area used for this survey is the open land area between Building 116 and Lockwood Street. It is similar in composition and topography to the Building 157 site. The reference area location is depicted in Figure 2-2. Preliminary reference area gamma measurements collected for the site are identified in Table 2-3.

2.2.4 Investigation Levels

The investigation level for gamma scan surveys will be three standard deviations (sigma) above the average gamma exposure rate in the reference area, as identified in Table 2-3.

2.2.5 Gamma Scans

Gamma scans will be effective for identifying elevated concentrations of ^{226}Ra. Gamma scans will not be effective for identifying ^{137}Cs and ^{60}Co at their respective release criterion. One-hundred percent of the Class 1 and 50 percent of the Class 2 survey units will be scanned with Ludlum Model 44-10 scintillation detectors coupled to Ludlum Model 2350-1 scaler/rate meters. The gamma scans will be performed in accordance with SOP HPO-Tt-006, *Radiation and Contamination Surveys* (TtFW, 2005b). A single detector or an array of detectors may be used to perform gamma scans. In each case, scans will be performed at a rate of approximately 0.08 meters per second (6-second scan observation) with the detector held approximately 10 cm (4 inches) above the ground. If a single detector is used, it will be moved back and forth across the travel path while scanning, producing a serpentine scan pattern. If a detector array is used, it will be pushed or pulled in a straight line with the detector centers positioned approximately 30 cm apart.

2.2.5.1 Minimum Detectable Count Rate for Gamma Surveys (2-inch by 2-inch NaI Probe)

MDCR is the minimum detectable number of net source counts in the scan interval, for an ideal observer, that can be arrived at by multiplying the square root of the number of background counts (in the scan

interval) by the detectability value associated with the desired performance (as reflected in *d'*), as shown in Equation 7-5 from the Base-wide Plan (TtFW, 2005a).

Equation 7-5 from the Base-wide Plan

$$MDCR = d'\sqrt{b_i}\left(\frac{60}{i}\right)$$

Where:

d'	=	index of sensitivity (α and β errors) = 3.28
b_i	=	number of background counts in scan time interval = 684 cpm
i	=	Scan or observation interval = 6 seconds

For this calculation, the observed background count rate of 6,842 cpm for ^{226}Ra, ^{60}Co, and ^{137}Cs were used. It should be noted that a typical source will remain under the sodium iodide (NaI) probe for 6 seconds during the scan; therefore, the average number of background counts in the observation interval is 684 [$b_i = 6{,}842 \times (6/60)$]. The required rate of true positives is 95 percent, and the false positives are 5 percent. From Table 6.5 of MARSSIM (NUREG-1575), the value of *d'*, representing this performance goal, is 3.28. Using these inputs, the MDCR for the Building 157 Site is calculated as 858 cpm for ^{226}Ra, ^{60}Co, and ^{137}Cs.

2.2.5.2 MDCR and Use of Surveyor Efficiency, Gamma (2-inch by 2-inch NaI probe)

The $MDCR_{Surveyor}$ can be calculated assuming a surveyor efficiency (*P*) of 0.5 and the observed background count rate of 6,842 cpm for ^{226}Ra, ^{60}Co, and ^{137}Cs using Equation 7-9 from the Base-wide Plan as follows:

Equation 7-9 from the Base-wide Plan

$$MDCR_{SURVEYOR} = \frac{MDCR}{\sqrt{P}} = \frac{858}{\sqrt{0.5}} = 1{,}213\,cpm$$

2.2.5.3 Scan MDC for Gamma Surveys (2-inch by 2-inch NaI probe)

The gamma scan MDC (in pCi/g) for land areas is based on the area of elevated activity, depth of contamination, and the radionuclide (i.e., energy and yield of gamma emissions). To establish the scan MDC, the relationship between the detector's net count rate to net exposure rate must be established first. This is accomplished by determining the MDCR using Equation 7-5 from the Base-wide Plan, as shown in Section 2.2.5.1 and then applying a surveyor efficiency factor *p* to get $MDCR_{Surveyor}$ as calculated by Equation 7-9 from the Base-wide Plan (TtFW, 2005a) above.

The corresponding minimum detectable exposure rate (MDER) is determined for a 2-inch by 2-inch NaI probe and the radionuclide of concern. When used with the Ludlum Model 2350-1, calibration records for the Ludlum Model 44-10 2-inch by 2-inch NaI scintillation detector provide information that can be used to determine the ratio of cpm to microroentgen per hour (µR/hr). This is accomplished with the use of a mathematical variable Ludlum refers to as the calibration constant. During calibration, the constant is determined for each detector using radiation from the isotope requested by the user, if available. By using the value of the calibration constant, as shown in Equation 7-10 from the Base-wide Plan (TtFW, 2005a), a dose rate can be calculated for a given count rate and vice versa.

Equation 7-10 from the Base-wide Plan

$$MDER\,(\mu R/hr) = \frac{MDCR_{SURVEYOR} * 6\times10^{7}}{cc}$$

Where:

$MDCR_{SURVEYOR}$ = 1,213 cpm
Cc = calibration constant = 6.090168 x 10^{10} (counts/R)
$6x10^{7}$ = a conversion factor accounting for differences in time and activity units (μR-min)/(R-hr)

The MDER for ^{226}Ra, ^{60}Co, and ^{137}Cs, calculated using Equation 7-10 from the Base-wide Plan (above), is 1.20 μR/hr.

Modeling (using Microshield™ Version 5.05 [Grove Engineering, 1996]) was used to determine the net exposure rate produced by 1.0 pCi/g of ^{226}Ra and its daughter products after 30 years of ingrowth in soil.

The physical and geometrical factors considered in the modeling included:

- The dose point of 4 inches above the soil was used.
- The density of 1.6 grams per cubic centimeter (g/cm^3) was used for soil.
- The depth of the area of elevated activity was 15 cm.
- The circular dimension of the cylindrical area of elevated activity was 0.25 m^2.

Using the above input parameters, Microshield Version 5.05 calculates the exposure rate to be 0.7384 μR/hr for ^{226}Ra (which accounts for buildup). The radionuclide concentration of ^{226}Ra (scan MDC) necessary to yield the MDER (1.20 μR/hr) may be calculated using Equation 7-11 from the Base-wide Plan (TtFWm 2995) as follows:

Equation 7-11 from the Base-wide Plan

$$^{226}Ra\ Scan\ MDC = \frac{1.0\,pCi/g\ (1.20\mu R/hr)}{0.7384\mu R/hr} = 1.62\ pCi/g$$

Modeling (using Microshield Version 5.05) was used to determine the net exposure rate produced by 0.113 pCi/g of ^{137}Cs in soil. The physical and geometrical factors considered were identical to those used above for the ^{226}Ra modeling.

Equation 7-11 from the Base-wide Plan

$$^{137}Cs\ Scan\ MDC = \frac{0.113\,pCi/g\ (1.20\mu R/hr)}{0.0295\mu R/hr} = 4.6\ pCi/g$$

Although the calculated scan MDC for ^{137}Cs is above the release criteria listed in Table 2-2, a dose model using Resrad Version 6.3 default parameters (Argonne National Laboratory, 2005) and the input value of the scan MDC of 4.6 pCi/g shows that the maximum residual dose a person would receive is 10.43 millirem per year (mrem/yr). However, the systematic soil samples will be used to model the dose and release the site.

Modeling (using Microshield Version 5.05) was used to determine the net exposure rate produced by 0.0361 pCi/g of ^{60}Co in soil. The physical and geometrical factors considered were identical to those used above for the ^{226}Ra modeling.

Equation 7-11 from the Base-wide Plan

$$^{60}Co\ Scan\ MDC = \frac{0.0361 pCi/g\ (1.20 \mu R/hr)}{0.0374 \mu R/hr} = 1.16 pCi/g$$

Although the calculated scan MDC for ^{60}Co is above the release criteria listed in Table 2-2, a dose model using Resrad Version 6.3 default parameters and the input value of the scan MDC of 1.16 pCi/g shows that the maximum residual dose a person would receive is 10.28 mrem/yr. However, the systematic soil samples will be used to model the dose and release the site.

2.2.6 Samples

Soil samples will be collected from within the top 15 cm of the surface at the specified systematic locations in the survey unit. Additional biased samples may be collected if elevated gamma scan survey results identify areas above the investigation level. Samples will be collected using SOP HPO-Tt-009, *Sampling Procedures for Radiological Surveys* (TtFW, 2005c). Samples will be analyzed in the field laboratory by gamma spectroscopy. Ten percent of the samples will then be forwarded to an outside laboratory for quality assurance verification of gamma spectroscopy analysis.

2.2.7 Static Measurements

Static gamma and exposure rate measurements will be collected from the specified systematic locations in each of the survey units. Additional biased measurements may be collected if elevated gamma scan survey results identify areas above the investigation level. The gamma and exposure rate measurements will be performed in accordance with SOP HPO-Tt-006, *Radiation and Contamination Surveys* (TtFW, 2005b).

For gamma surveys, MDC is calculated in cpm. Equation 7-12 from the Base-wide Plan (TtFW, 2005a) is used to calculate the MDC.

Equation 7-12 from the Base-wide Plan

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{T_B}$$

Where:

3+4.65	=	constant factor provided in MARSSIM
R_B	=	background count rate (cpm) = 6,842
T_B	=	background counting time (min) = 1

Using the inputs observed in the reference area (listed above) in Equation 7-12, the calculated MDC for the Ludlum Model 2350-1 is 388 cpm for ^{226}Ra, ^{60}Co, and ^{137}Cs.

2.2.8 Exposure Rate Measurements

Exposure rate measurements will be collected from the specified systematic and biased locations in each of the Class 1 and Class 2 survey units. Additional measurements will be collected if elevated areas are identified while performing the gamma scan surveys. Ludlum Model 19 exposure rate meters will be used to perform the measurements.

2.2.9 Drainage Systems

Once the Class 1 and Class 2 surveys have been completed, the drainage system will be removed under the ongoing work under the Base-wide Storm Drain and Sanitary Sewer Removal Plan and Parcel B Design Plan.

3.0 QUALITY CONTROL

The data quality objectives for the survey are provided in Table 3-1.

Definable features of work (DFW) establish the measures required to verify both the quality of work performed and compliance with project requirements. The DFW for this task is radiological surveys.

A description of this DFW and the associated phases of quality control are presented in Table 3-2.

4.0 ENVIRONMENTAL PROTECTION

Only environmental protection-driven requirements addressed in the Base-wide Plan apply.

5.0 REFERENCES

The following additional references not already in the Base-wide Plan are cited in this TSP:

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Grove Engineering. 1996. MicroShield™ Version 5.05 software. Grove Engineering: Rockville, Maryland.

San Francisco Redevelopment Agency (SFRA). 1997. *Hunters Point Shipyard Redevelopment Plan.* July.

Tetra Tech EC, Inc. 2006. *Final Project Work Plan.* Base-wide Storm Drain and Sanitary Sewer Removal, Hunters Point Shipyard, San Francisco, California. DCN: FWSD-RAC-06-0355. April 21.

Tetra Tech FW, Inc. (TtFW). 2005a. *Base-wide Radiological Work Plan, Hunters Point Shipyard, San Francisco, California.* DCN: FWSD-RAC-05-0165. February.

TtFW. 2005b. Final Hunters Point Shipyard Project Standard Operating Procedure. *Radiation and Contamination Surveys.* HPO-Tt-006. DCN: FWSD-RAC-05-1046. Revision 0. April 19.

TtFW. 2005c. Final Hunters Point Shipyard Project Standard Operating Procedure. *Sampling Procedures for Radiological Surveys.* HPO-Tt-009. DCN: FWSD-RAC-05-0473. Revision 0. February 16.

TtFW. 2004. *Final Base-wide Health and Safety Plan.* Hunters Point Shipyard, San Francisco, California.

TABLES

TABLE 2-1

EQUIPMENT AND MATERIAL SURFACE CONTAMINATION LIMITS

Radionuclide	Loose (dpm/100 cm^2)	Fixed (dpm/100 cm^2)
Alpha	20 α	100 α
Beta / Gamma	1,000 β^-, γ	5,000 β^-, γ

Notes:

Types of radiation: α - alpha, γ - gamma, β^- - beta
cm^2 – square centimeters
dpm – disintegrations per minute

TABLE 2-2

BUILDING 157 SITE
PRIMARY RADIATION PROPERTIES AND RELEASE CRITERIA
FOR RADIONUCLIDES OF CONCERN

Radionuclide	Primary Radiation Properties		Release Criteria for Residential - Soil[a] (pCi/g)
	Half-life	Type	
^{226}Ra	1600 y	Alpha Gamma	1.0[b]
^{60}Co	5.271 y	Beta	0.0361
^{137}Cs	30.17 y	Beta Gamma	0.113

Notes:

[a] U.S. Environmental Protection Agency (EPA) Preliminary Remediation Goals (PRGs) for soil, except as noted

[b] Limit is 1 pCi/g above background, per agreement with EPA.

^{226}Ra – radium-226

^{60}Co – cobalt-60

^{137}Cs – cesium-137

pCi/g – picocurie per gram

y – year

TABLE 2-3

AREA BEHIND BUILDING 157
REFERENCE AREA GAMMA STATIC MEASUREMENTS

Ludlum Model 2350-1 S/N: 129423		Detector 44-10 S/N: PR196022	Cal Due: 6/16/2006
Sample #	**Count Time**	**Counts**	**Net Counts**
1	60 seconds	6953	6953
2	60 seconds	6676	6676
3	60 seconds	6783	6783
4	60 seconds	6649	6649
5	60 seconds	6618	6618
6	60 seconds	6745	6745
7	60 seconds	6983	6983
8	60 seconds	7038	7038
9	60 seconds	7021	7021
10	60 seconds	6928	6928
11	60 seconds	6744	6744
12	60 seconds	6747	6747
13	60 seconds	6996	6996
14	60 seconds	6942	6942
15	60 seconds	6657	6657
16	60 seconds	6992	6992
		Mean	6,842
		Sigma (σ)	152
		3 σ	456
	Investigation Level (3 σ + Bkgd.)		*7,298

Notes:

* This value is preliminary data collected from the site. The actual investigation level will be based on the data collected during the reference area survey conducted in accordance with this Task-specific Plan.

TABLE 3-1

SUMMARY OF DATA QUALITY OBJECTIVES

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
Statement of Problem	**Decisions**	**Inputs to the Decisions**	**Boundaries of the Study**	**Decision Rules**	**Limits on Decision Errors**	**Optimize the Sampling Design**
Building 157 is listed as an area impacted by radiological activities. Isotopes of concern are: ^{137}Cs, ^{226}Ra, and ^{60}Co. It must be determined if the site-specific release criteria for these isotopes have been met or if remediation is warranted.	The primary use of the data expected to result from completion of this TSP is to support the Final Status Survey for the former Building 157 Site. Therefore, the decision to be made can be stated as, "Do the results of the survey meet the release criteria?	Radiological surveys required to support the scoping survey of Building 157 will include: • 100% alpha and beta scan surveys of the building structure and concrete slab. • 100% gamma scan surveys of the Class 1 survey units. • 50% gamma scan surveys of the Class 2 survey unit. • A minimum of 32 systematic static alpha, beta and swipe measurements will be performed on the building surfaces and concrete pad. • A minimum of 16 systematic gamma, exposure rate, and solid samples will be collected in each Class 1 and Class 2 survey unit. • Additional biased measurement and sample data will be collected if investigation levels are exceeded.	The lateral spatial boundaries for this survey effort are shown in Figure 2-1. Vertically, soil samples will be collected within 15 cm of the soil surface.	If the results of the survey meet the release criteria, then the data will be used to support a Final Status Survey. *Note*: if areas of elevated activity are observed, a separate plan will be prepared for the performance of characterization surveys and possible remedial action, which may include sampling at depths > 15 cm.	Limits on decision errors are set at 5% as specified in the Base-wide Plan.	Operational details for the radiological survey process have been developed. The theoretical assumptions are based on guidelines contained in MARSSIM. Specific assumptions regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected, and investigation levels are contained in this plan and the Base-wide Plan.

Notes:

cm – centimeter
^{60}Co – cobalt-60
^{137}Cs – cesium-137
MARSSIM – Multi-Agency Radiation Survey and Site Investigation Manual
^{226}Ra – radium-226
TSP – Task-specific Plan

TABLE 3-2

DEFINABLE FEATURES OF WORK FOR RADIOLOGICAL SURVEYS

ACTIVITY	PREPARATORY (Prior to initiating survey activity)	DONE	INITIAL (At outset of survey activity)	DONE	FOLLOW-UP (Ongoing during survey activity)	DONE
Radiological surveys	• Verify that an approved TSP is in place. • Verify that the RPM, the RSO, and CSO are notified about mobilization. • Verify that an approved RWP is available and has been read and signed by assigned personnel. • Verify that Base-wide Plan, BHASP, TSP, and AHAs have been reviewed. • Verify that assigned personnel are trained and qualified. • Verify that personnel have been given an emergency notification procedure. • Verify that workers assigned dosimetry have completed NRC Form 4. • Verify that the relevant SOPs and/or manufacturers' instructions are available and have been reviewed for equipment to be used for radiological surveys. • Verify that equipment is on site and is in working order (initial daily check).		• Verify that radiological instruments are as specified in the Base-wide Plan and TSP. • Inspect training records. • Verify that a qualified RCT and SHSS are present at active work areas. • Verify that site activities are being photographed. • Verify that the reference area measurements have been obtained using the procedure described in the Base-wide Plan, which states that the same survey methodology and instruments used to collect the background data will be used to perform measurements within survey units. • Verify that daily checks were performed on all portable survey instruments. • Verify that radiological instrument calibrations and setup are current. • Verify that required dosimetry is being worn. • Verify that field logbooks, proper forms, and chain-of-custody documents are in use. • Verify that samples and measurements are being collected in accordance with the TSP, the Base-wide plan, and relevant SOPs. • Verify that sample handling and analyses are in accordance with the Base-wide Plan and applicable SOPs.		• Verify that the site is properly posted and secured, if necessary. • Conduct ongoing inspection of material and equipment. • Verify that a qualified RCT and SHSS are present at active work areas. • Verify that daily instrument checks and background measurements were obtained and documented. • Verify that survey and sample analysis results are documented. • Verify that personnel have read and signed revised RWP, if revision is required. • Inspect sample chain-of-custody and survey log for completeness. • Verify that survey and analytical activities conform to the TSP. • Verify that survey instruments are recalibrated after repairs or modifications. • Verify that site activities are being photographed. • Verify that survey documentation is reviewed by the RTS.	

Notes: AHA – Activity Hazard Analysis
BHASP – Building-Specific Health and Safety Plan
NRC – Nuclear Regulatory Commission
RCT – Radiological Control Technician
RPM – Remedial Project Manager
RSO – Radiological Safety Officer
RTS – Radiological Task Supervisor
RWP – Radiation Work Permit
SHSS – Site Health and Safety Specialist
SOP – Standard Operating Procedure
TSP – Task-specific Plan

FIGURES

FIGURE 2-1

BUILDING 157 SITE LAYOUT AND SAMPLING POINTS

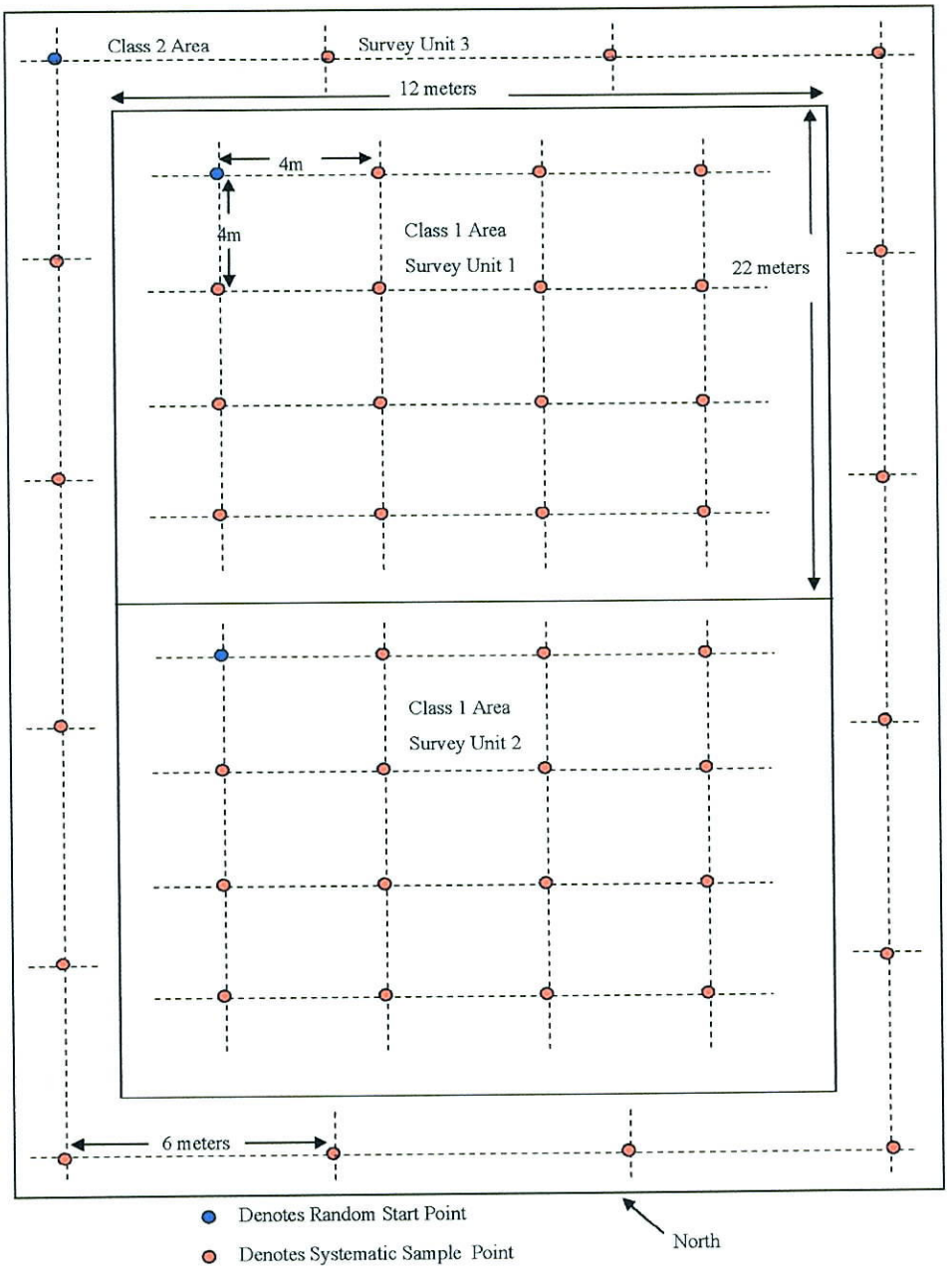

FIGURE 2-2

BUILDING 157 AND REFERENCE AREA